L2GEN MODIS Ocean Science Processing Algorithm

MODIS L2GEN_SPA

General

The NASA Goddard Space Flight Center's (GSFC) Direct Readout Laboratory (DRL), Code 606.3, developed this wrapper software for the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) In-Situ Ground System (NISGS) and the International Polar Orbiter Processing Package (IPOPP).

Users must agree to all terms and conditions in the Software Usage Agreement on the DRL Web Portal before downloading this software.

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Algorithm Wrapper Concept

The DRL has developed an algorithm wrapper to provide a common command and execution interface to encapsulate multi-discipline, multi-mission science processing algorithms. The wrapper also provides a structured, standardized technique for packaging new or updated algorithms with minimal effort.

A Science Processing Algorithm (SPA) is defined as a wrapper and its contained algorithm. SPAs will function in a standalone, cross-platform environment to serve the needs of the broad Direct Readout community. Detailed information about SPAs and other DRL technologies is available at:

http://directreadout.sci.gsfc.nasa.gov/index.cfm?section=technology

Software Description

This software package contains the MODIS L2GEN_SPA. The L2GEN algorithm (formerly the MSL12 algorithm) was extracted from the Ocean Biology Processing Group's (OBPG) SeaWiFS Data Analysis System (SeaDAS). This SPA produces MODIS Level 2 Ocean Color (daytime product, includes Chlorophyll-a concentration) and Sea Surface Temperature (SST) products from inputs of MODIS Level 1B 1km (MOD021KM/MYD021KM) products, MODIS Geolocation (MOD03/MYD03) products, and other optional ancillary files.

This command-line implementation serves as a source of scientific algorithms for the MODIS SST and Chlor-a products only. For more information on the complete

SeaDAS Processing Package, you may refer to the OBPG's site located at:

http://oceancolor.gsfc.nasa.gov/seadas/

Software Version

Version 1 of the DRL algorithm wrapper was used to package the SPA described in this document. The SPA uses the L2GEN (Version 5.8.9) processing code embedded within the SeaDAS (Version 5.3) to generate MODIS L2 Ocean products. Version 5.8.9 includes improved ancillary file logic, to provide the highest-quality science data for real-time applications. It also includes a day and night pass check for the chlor_a product (i.e., the chlor_a product will not be processed for night passes). This package has been tested successfully on Fedora Core 4 and Core 6 platforms.

Credits

SeaDAS and its component L2GEN algorithm were provided to the DRL by the OBPG at NASA GSFC.

Prerequisites

To run this package, you must have the Java Development Kit (JDK) or Java Runtime Engine (JRE) (Java 1.5 or higher) installed on your computer, and have the Java installation bin/ subdirectory in your PATH environment variable.

Program Inputs and Outputs

This SPA uses the MODIS 1km L1B Calibrated Geolocated Radiances (MOD021KM, MYD021KM) HDF product and the MODIS Geolocation HDF product (MOD03, MYD03), along with ancillary meteorology, ozone and SST files as inputs. Outputs are the MODIS Level 2 SST and Ocean Color products.

Installation and Configuration

This section contains instructions for installing an SPA in a standalone configuration. SPAs may also be installed dynamically into an IPOPP framework; instructions for this type of installation are contained in the IPOPP User's Guide.

Download the l2gen5.8.9_SPA.tar.gz and l2gen5.8.9_SPA_testdata.tar.gz (optional) files into the same directory.

Decompress and un-archive the l2gen5.8.9_SPA.tar.gz and l2gen5.8.9_SPA_testdata.tar.gz (optional) files:

```
$ tar -xzf  l2gen5.8.9_SPA.tar.gz
$ tar -xzf l2gen5.8.9_SPA_testdata.tar.gz
```

This will create the following subdirectories:

- SPA
  - l2gen
    - algorithms
    - ancillary
    - wrapper
    - stations
    - testscripts
    - testdata

Software Package Testing and Validation

The testscripts subdirectory contains test scripts that can be used to verify that your current installation of the SPA is working properly, as described below. Note that the optional l2gen5.8.9_SPA_testdata.tar.gz file is required to execute these testing procedures.

Step 1: cd into the testscripts directory.

Step 2: There are two scripts inside the testscripts directory: 'run-sst' and 'run-chlor_a'. Run the scripts one by one. For example, to run the SST algorithm, use:

```
$./run-sst
```

To run the Ocean Color algorithm, use:

```
$./run-chlor-a
```

A successful execution usually takes some time (around 5 minutes, depending on the speed of your computer), so if the execution seems to get stuck with an "Awaiting Completion" message, do not become impatient. If everything is working properly, the scripts will terminate with a message such as:

Output modis.sst is

/home/ipopp/SPA/l2gen/testdata/output/SST.07062142913.hdf

You can cd to the output directory to verify that the science product really exists. If it exists, then the SPA works perfectly. Test output product(s) are available for comparison in the testdata/output directory. These test output product(s) were generated on a 64-bit PC architecture computer running Linux Fedora Core 4. Use a comparison utility (such as diff, hdiff, etc.) to compare your output product(s) to those provided in the testdata/output directory. If there is a problem and the code terminates abnormally, the problem can be identified using the log files. Log files are automatically generated within the directory used for execution. They start with stdfile* and errfile*. Please report any errors that cannot be fixed to the DRL. You can delete the log files after execution.

Program Operation

In order to run the package using your own input data, you can either use the run scripts within the wrapper subdirectories, or modify the test scripts within the testscripts subdirectory.

To Use the Run Scripts

Identify the 'run' scripts: The wrapper directory within this package contains two subdirectories, one for generating each of the two products (i.e., the Ocean Color and SST products). Each subdirectory contains an executable called 'run'. Execute 'run' within the correct wrapper subdirectory to generate the corresponding product. For instance, the 'run' within wrapper/sst is used for creating MODIS SST products, while the 'run' within wrapper/chlor_a should be used for creating MODIS Ocean Color products. Note that to execute 'run', you need to have java on your path.

Specify input parameters using <label value> pairs: To execute the 'run' scripts, you must supply the required input and output parameters. Input and output parameters are usually file paths or other values (e.g., an automatic search flag). Each parameter is specified on the command line by a <label value> pair. Labels are simply predefined names for parameters. Each label must be followed by its actual value. Each process has its own set of <label value> pairs that must be specified in order for it to execute. Some of these pairs are optional, meaning the process would still be able to execute even if that parameter is not supplied. There are three types of <label value> pairs that the MODIS L2GEN_SPA uses, as follows:

a) Input file label/values. These are input file paths. Values are absolute or relative paths to the corresponding input file.

b) Parameter label/values. These are parameters that need to be passed onto the SPA (e.g., an automatic search flag).

c) Output file labels. These are output files that are produced by the SPA. Values are the relative/absolute paths of the files you want to generate.

The following tables contains labels, and their descriptions, required by the MODIS L2GEN_SPA.

Input File Labels	Description	Source
modis.mxd021km	MODIS 1km L1B Calibrated Geolocated Radiances HDF file (MOD021KM, MYD021KM)	DRL ftp site for real-time MODIS L1B and geolocation products over eastern US region: Terra ftp://is.sci.gsfc.nasa.gov/gsfcdata/terra/modis/level1/ Aqua ftp://is.sci.gsfc.nasa.gov/gsfcdata/aqua/modis/level1/ Datasets from your Direct Readout Station/DAAC
modis.mxd03	MODIS Geolocation HDF file (MOD03, MYD03)	
ncep_met_1 (optional)	Directory path and filename of the climatological product or the Near-Real Time (NRT) National Centers for Environmental Prediction (NCEP) meteorological ancillary data product available for the nearest time preceding the time of L1B product's first scan line.	For recent meteorological ancillary files: ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/global/oceansmet For archived meteorology ancillary files: ftp://oceans.gsfc.nasa.gov/METOZ/
ncep_met_2 (optional)	Directory path and filename of the NRT NCEP meteorological ancillary data product available for the nearest time following the time of L1B product's first scan lines.	
ncep_met_3 (optional)	Directory path and filename of the NRT NCEP meteorological ancillary data product for the nearest time following the time of L1B product's last scan line.	

Input File Labels	Description	Source
obpg.noaa_toast_1 (optional)	Directory path and filename of the climatological product or the NRT ozone ancillary data product available for the nearest time preceding the time of the L1B product's first scan line. Ancillary ozone data can come from the Earth Probe Total Ozone Mapping Spectrometer (EPTOMS) or Total Ozone Analysis using SBUV/2 and TOVS (TOAST).	For recent ozone ancillary files: ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/global/oceanstoast For archived ozone ancillary files: ftp://oceans.gsfc.nasa.gov/METOZ/
opbg.noaa_toast_2 (optional)	Directory path and filename of the NRT ozone ancillary data product (EPTOMS or TOAST) available for the nearest time following the time of the L1B product's first scan lines.	
obpg.noaa_toast_3 (optional)	Directory path and filename of the NRT ozone ancillary data product (EPTOMS or TOAST) for the nearest time following the time of the L1B product's last scan line.	
noaa_oisst (optional)	Directory path and filename of the weekly NOAA Optimum Interpolated SST (OISST) ancillary input for the time period corresponding to the L1B granule.	For recent OISST ancillary file: ftp://is.sci.gsfc.nasa.gov/ancillary/temporal/global/sst For archived OISST ancillary files: ftp://oceans.gsfc.nasa.gov/OISST/

Input File Labels	**Description**	**Source**
l2gen_chlor_paramfile (optional, only for Ocean Color product)	Allows specification of a parameter file to the SPA. The parameter file allows the user to set various algorithm control parameters. In case the label is not specified, a default parameter file for the Ocean Color product is used.	
l2gen_sst_paramfile (optional, only for SST product)	Allows specification of a parameter file to the SPA. The parameter file allows the user to set various algorithm control parameters. In case the label is not specified, a default parameter file for SST product is used.	

Parameter Labels	**Description**
metsearch	Values can be either 'yes' or 'no'. Enables automatic search for meteorological ancillary files when set to 'yes'.
ozonesearch	Values can be either 'yes' or 'no'. Enables automatic search for ozone ancillary files when set to 'yes'.
sstsearch	Values can be either 'yes' or 'no'. Enables automatic search for OISST ancillary files when set to 'yes'.
Output File Labels	**Description**
modis.chlor_a (only for Ocean Color product)	MODIS Ocean Color output HDF file path
modis.sst (only for SST product)	MODIS SST output HDF file path

Notes on ancillary inputs:

1. **Meteorology:** During near-real time DB processing, you may either use ncep.met.1 only to specify a single meteorology input, or specify no meteorology ancillary inputs at all. In case none of the three optional meteorology inputs is specified, a default climatological meteorology product (included with this package) will be used automatically. However during non-real time processing, the user may use all three meteorological ancillary inputs. The following paragraph explains the logic used when various combinations of these optional meteorology ancillaries are used.

   If ncep_met_2 is not used and ncep_met_1 is an NRT product, then ncep_met_2 will be set to ncep_met_1. If ncep_met_1 <> ncep_met_2 and the scan line's date and time fall between the times of ncep_met_1 and ncep_met_2, interpolated meteorological values will be used. (If the scan line's date and time fall before those of ncep_met_1, an error occurs.) If ncep_met_1 = ncep_met_2 and the scan line's date and time fall before ncep_met_2, only ncep_met_2 will be used to generate the meteorological values. If ncep_met_2 <> ncep_met_3 and the scan line's date and time fall between the times of ncep_met_2 and ncep_met_3, ncep_met_2 and ncep_met_3 will be used to generate the interpolated meteorological values. (If the scan line's date and time fall after those of ncep_met_3, an error occurs.) If ncep_met_2 = ncep_met_3 and the scan line's date and time fall after ncep_met_2, only ncep_met_2 will be used to generate the meteorological values. If ncep_met_3 is not specified and ncep_met_1 is an NRT product, then ncep_met_3 will be set to ncep_met_2 and the logic specified for ncep_met_2 will be applied.

2. **Ozone:** During NRT DB processing, you may either use obpg.noaa_toast_1 only to specify a single ozone input, or specify no ozone ancillary inputs at all. In case none of the three optional ozone inputs is specified, a default ozone product (included with this package) will be used automatically. However during non-real time processing, the user may use all three ozone ancillary inputs. The next paragraph explains the logic used when various combinations of these optional ozone ancillaries are specified.

   If obpg.noaa_toast_2 is not specified and obpg.noaa_toast_1 is an NRT product, then obpg.noaa_toast_2 will be set to obpg.noaa_toast_1. If obpg.noaa_toast_1 <> obpg.noaa_toast_2 and the scan line's date and time fall between the times of obpg.noaa_toast_1 and obpg.noaa_toast_2, obpg.noaa_toast_1 and obpg.noaa_toast_2 will be used to generate the interpolated ozone values. (If the scan line's date and time fall before those of obpg.noaa_toast_1, an error occurs.) If obpg.noaa_toast_1 = obpg.noaa_toast_2 and the scan line's date and time fall before obpg.noaa_toast_2, only obpg.noaa_toast_2 will be used to generate the ozone values. If obpg.noaa_toast_2 <> obpg.noaa_toast_3 and the scan line's date and time fall between the times of obpg.noaa_toast_2 and obpg.noaa_toast_3, obpg.noaa_toast_2 and obpg.noaa_toast_3 will be used to generate the interpolated ozone values. (If the scan line's date and time fall after those of obpg.noaa_toast_3, an error occurs.) If obpg.noaa_toast_2 = obpg.noaa_toast_3 and the scan line's date and time fall after obpg.noaa_toast_2, only obpg.noaa_toast_2 will be used to generate the ozone values. If obpg.noaa_toast_3 is not specified and obpg.noaa_toast_1 is an NRT product, then obpg.noaa_toast_3 will be set to obpg.noaa_toast_2, and the logic specified for obpg.noaa_toast_2 will be applied. (For TOVS data, the center point time is used to represent the time of that product.)

3. **SST:** If the noaa_oisst input is not specified, a default climatological SST ancillary (included with this package) will be used automatically.

4. **Automatic Search Options:** The labels metsearch, ozonesearch and sstsearch can be set to 'yes' to enable automatic search and download of optimum ancillary meteorology, ozone and sst inputs respectively. If set to 'yes' these downloaded optimum ancillaries will override any ancillary inputs specified using the ncep_met_x, obpg.noaa_toast_x and noaa_oisst labels. In order to avoid this override, the corresponding search labels should be set

to 'no' when using your own ancillary inputs.

Parameter Files

In general a user need not specify an external parameter file. Refer to the Appendix for additional information on how to use parameter files.

Execute the 'runs': The following are examples of command lines to run the Ocean Color and SST algorithms respectively from the testscripts directory:

```
$ ../wrapper/chlor_a/run \
   modis.mxd021km ../testdata/input/MOD021KM.07062142913.hdf \
   modis.mxd03 ../testdata/input/MOD03.07062142913.hdf \
   modis.chlor_a ../testdata/output/CHLOR_A.07054183325.hdf \
   ncep_met_1 ../testdata/input/S200706206_NCEP.MET \
   obpg.noaa_toast_1 ../testdata/input/S20070630006323_TOAST.OZONE \
   noaa_oisst ../testdata/input/oisst.20070228\
   metsearch no \
   ozonesearch no \
   sstsearch no
```

```
$ ../wrapper/sst/run \
   modis.mxd021km ../testdata/input/MOD021KM.07062142913.hdf \
   modis.mxd03 ../testdata/input/MOD03.07062142913.hdf \
   modis.sst ../testdata/output/SST.07054183325.hdf \
   ncep_met_1 ../testdata/input/S200706206_NCEP.MET \
   obpg.noaa_toast_1 ../testdata/input/S20070630006323_TOAST.OZONE \
   noaa_oisst ../testdata/input/oisst.20070228\
   metsearch no \
   ozonesearch no \
   sstsearch no
```

A successful execution of 'run' usually takes some time (around 5 minutes, depending on the speed of your computer), so if the execution seems to get stuck with an "Awaiting Completion" message, do not become impatient. If execution fails, you will see an error message indicating the cause of failure (e.g., a file cannot be found, or a label cannot be recognized). Correct it and run again. If the problem has some other cause, it can be identified using the log files. Log files are automatically generated within the directory used for execution. They start with stdfile* and errfile* and can be deleted after execution. Additionally *_list files will be generated when any automatic search is set to 'yes'. These can also be deleted after execution. Please report any errors that cannot be fixed to the DRL. The 'run' can be executed from any directory the user chooses. This can be done by prefixing it with the file path for the 'run' script.

To Use the Scripts in the testscripts Directory

One simple way to run the algorithms from any directory of your choice using your own data is to copy the run-sst or run-chlor_a script from the testscripts directory to the selected directory. Change the values of the variables like WRAPPERHOME, L1HOME and OUTPUTHOME to reflect the file paths of the wrapper directories and the input/output file paths. Then modify the input/output file name variables. Run the script to process your data.

Appendix
Parameter Files

The l2gen_chlor_a_paramfile and l2gen_sst_paramfile labels provide the user with an opportunity to pass in a parameter file for Ocean Color and SST processing, respectively. The parameter file uses a keyword-value pair structure to specify various parameters that control algorithm processing and the output content. A user may want to use a parameter file input if he wishes to override the default values of any parameter (a Parameter File Keyword List is included in this Appendix). The default values of these parameters are specified in an msl12_defaults.par file within algorithm/data/modisa (for Aqua), and algorithm/data/modist (for Terra). L2GEN_SPA always reads the defaults file first, to initialize the processing. Any parameters specified via a user-supplied parameter file will override the values specified in msl12_defaults.par.

In general the user need not specify an external parameter file. In this case the parameter files l2gen_chlor_a_paramfile and l2gen_custom_sst.par (in SPA/l2gen/algorithm/DRL_custom_paramfiles) are used automatically (in addition to the sensor-specific msl12_defaults.par). These custom parameter files provided by the DRL only override the 'l2prod' parameter that controls the dataset content of the output HDF products. The SPA initializes the rest of the parameter values from the sensor-specific msl12_defaults.par files. A list of all possible algorithm control options and output datasets that may be specified in the parameter file is provided in this Appendix.

Parameter File Keyword List

Arguments/Keywords:

l2prod	The list of product names to be included in the output file **ofile**. (Refer to the L2GEN Output Product List Table in this Appendix.)
ofile[1-4]	Directory path and filename of the output L2 files containing the products by the **l2prod[1-4]** keyword.
l2prod[1-4]	The product names to be output to **ofile[1-4]**.
spixl	Starting pixel number to be processed. (Default=1).
epixl	Ending pixel number to be processed. (Default=0, meaning the end of the scanline).
dpixl	Pixel subsampling rate. (Default=1).
sline	Starting scan line number to be processed. (Default=1).
eline	Ending scan line number to be processed. (Default=0,meaning the last line of the file).
dline	Line subsampling rate. (Default=1).
slat	Starting latitude to be processed. (Default=0).
elat	Ending latitude to be processed. (Default=0).
slon	Starting longitude to be processed. (Default=0).
elon	Ending longitude to be processed. (Default=0).
ctl_pt_incr	Control-point pixel increment for lon/lat arrays. (0= optimize, default = 8)

Additional required input data files:

met1	Directory path and filename of the climatological product or the near-real-time (NRT) meteorological ancillary data product available for the nearest time preceding **L1B produc**t's first scan line. If **met1** is the climatological file, then **met2** and **met3** will not be used, otherwise, see **met2** for logic. (Default: met1=$OCDATAROOT/common/S19461993_COADS_GEOS1.MET_noon).
met2	Directory path and filename of the NRT meteorological ancillary data product available for the nearest time following the time of **L1B** product's first scan lines. If **met2** is not specified (null) and **met1** is a NRT product, then **met2** will be set to **met1**. If **met1** <> **met2** and the scan line's date and time, fall between the times of **met1** and **met2**, get_ancillary will use

	met1 and **met2** to generate the interpolated meteorological values (if the scan line's date and time fall before those of **met1**, an error occurs). If **met1** = **met2** and the scan line's date and time fall before **met2**, get_ancillary will use only **met2** to generate the meteorological values. If **met2** <> **met3** and the scan line's date and time fall between the times of **met2** and **met3**, get_ancillary will use **met2** and **met3** to generate the interpolated meteorological values (if the scan line's date and time fall after those of **met3**, an error occurs). If **met2** = **met3** and the scan line's date and time fall after **met2**, get_ancillary will use only **met2** to generate the meteorological values.
met3	Directory path and filename of the NRT meteorological ancillary data product for the nearest time following the time of **L1B** product's last scan line. If **met3** is not specified (null) and **met1** is a NRT product, then **met3** will be set to **met2** and the logic specified in **met2** will be applied.
ozone1	Directory path and filename of the climatological product or the NRT ozone ancillary data product available for the nearest time preceding the time of **L1B** product's first scan line. If **ozone1** is the climatological file, then **ozone2** and **ozone3** will not be used, otherwise see **ozone2** for logic. (For TOVS data, the center point time is used to represent the time of that product.). (Default: ozone1=$OCDATAROOT/common/S19891991_TOMS.OZONE).
ozone2	Directory path and filename of the NRT ozone ancillary data product available for the nearest time following the time of **L1B** product's first scan lines. If **ozone2** is not specified (null) and **ozone1** is a NRT product, then **ozone2** will be set to **ozone1**. If **ozone1** <> **ozone2** and the scan line's date and time, fall between the times of **ozone1** and **ozone2**, get_ancillary will use **ozone1** and **ozone2** to generate the interpolated ozone values (if the scan line's date and time fall before those of **ozone1**, an error occurs). If **ozone1** = **ozone2** and the scan line's date and time fall before **ozone2**, get_ancillary will use only **ozone2** to generate the ozone values. If **ozone2** <> **ozone3** and the scan line's date and time fall between the times of **ozone2** and **ozone3**, get_ancillary will use **ozone2** and **ozone3** to generate the interpolated ozone values (if the scan line's date and time fall after those of **ozone3**, an error occurs). If **ozone2** = **ozone3** and the scan line's date and time fall after **ozone2**, get_ancillary will use only **ozone2** to generate the ozone values. (For TOVS data, the center point time is used to represent the time of that product.)
ozone3	Directory path and filename of the NRT ozone ancillary data product for the nearest time following the time of **L1B** product's last scan line. If **ozone3** is not specified (null) and **ozone1** is a NRT product, then **ozone3** will be set to **ozone2** and the logic specified in **ozone2** will be applied. (For TOVS data, the center point time is used to represent the time of that product.)
land	Directory path and filename of the land-mask input file. (Default: land=$OCDATAROOT/common/landmask.dat)
water	Directory path and filename of the shallow water mask input file used for setting the l2_flags bit to indicate shallow water (defined as 30m) areas (McClain et al. 1995).(Default: water=$OCDATAROOT/common/watermask.dat)
icefile	Directory path and filename of the ice-mask input file. (Default: icefile=$OCDATAROOT/common/ice_mask.hdf)

sstfile	Directory path and filename of the climatological SST input data, this is currently used to set the tricodesmium flag. For MODIS Aqua processing, OISST files can be specified here for the SSTguess in the non-linear SST algorithm(NLSST). (Default: sstfile=$OCDATAROOT/common/sst_climatology.hdf).
calfile	System calibration file

Calibration control options:

gain	Calibration gain factors to multiply TOA radiance in each band; the default gain values are read from the $MSL12_DATA/*sensor*/*sensor*_table.dat file.
offset	Calibration offset adjustment to TOA radiance; the default gain values are read from the $MSL12_DATA/*sensor*/*sensor*_table.dat file.

Algorithm control options:

proc_ocean	Apply ocean processing. 1= On, 0 = Off. (Default is On).
atm_ocor	Apply atmospheric correction. 1= On, 0 = Off. (Default is On).
proc_land	Apply land processing. 1= On, 0 = Off. (Default is Off).
proc_sst	Apply SST processing. 1= On, 0 = Off. (Default is On). (MODIS Only)
mode	Processing mode: 0:forward processing (default) 1:inverse (calibration) mode, targeting to nLw=0 2:inverse (calibration) mode, given nLw target 3: inverse (calibration) mode, given Lw target (internally normalized)
filter_file	Directory path and filename of the filter file that contains the filter method and information to be applied to the L1B data when **filter_opt** is set to 1. (Default=$MSL12_DATA/*sensor/sensor*_filter.dat).
filter_opt	Option for filtering the L1B data with the method specified in **filter_file**. 1=apply filtering , 0=do not apply filtering. (Default for OCTS=1, Default for others=0).
brdf_opt	Option for running bi-directional reflectance correction factor: 7: Morel f/Q + Fresnel solar + Fresnel sensor 3: Fresnel reflection/refraction correction for sensor + solar path 1: Fresnel reflection/refraction correction for sensor path 0: no correction
iop_opt	IOP model for use in downstream products (default:none) 0: None (products requiring *a* or *bb* will fail 1: Carder 2: GSM01 3: QAA

<table>
<tr><td>pol_opt</td><td colspan="2">polarization correction (MODIS only):
4: all radiance polarized like Rayleigh + Glint
3: only Rayleigh and Glint are polarized [MODIS default]
2: all radiance polarized like Rayleigh
1: only Rayleigh component is polarized
0: no correction</td></tr>
<tr><td>qaa_opt</td><td colspan="2">QAA IOP model options
0: blending
1: use 555
2: use 640</td></tr>
<tr><td>qaa_S</td><td colspan="2">QAA IOP model, spectral slope for adg (default:0.015)</td></tr>
<tr><td>outband_opt</td><td colspan="2">out-of-band correction for water-leaving radiances
(2: On, 0:Off, default: 2 - MODIS, SeaWiFS, OCTS, POLDER, 0 - MOS, OSMI)</td></tr>
<tr><td>glint_opt</td><td colspan="2">glint correction (1: On [default], 0: Off)</td></tr>
<tr><td rowspan="17">aer_opt</td><td colspan="2">Option for aerosol calculation mode. (SeaWiFS and OCTS Default = -3)</td></tr>
<tr><td>1</td><td>Multi-scattering with fixed model (Oceanic, 99% humidity)</td></tr>
<tr><td>2</td><td>Multi-scattering with fixed model (Maritime, 50% humidity)</td></tr>
<tr><td>3</td><td>Multi-scattering with fixed model (Maritime, 70% humidity)</td></tr>
<tr><td>4</td><td>Multi-scattering with fixed model (Maritime, 90% humidity)</td></tr>
<tr><td>5</td><td>Multi-scattering with fixed model (Maritime, 99% humidity)</td></tr>
<tr><td>6</td><td>Multi-scattering ,with fixed model (Coastal, 50% humidity)</td></tr>
<tr><td>7</td><td>Multi-scattering with fixed model (Coastal, 70% humidity)</td></tr>
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<tr><td>9</td><td>Multi-scattering with fixed model (Coastal, 99% humidity)</td></tr>
<tr><td>10</td><td>Multi-scattering ,with fixed model (Tropospheric, 50% humidity)</td></tr>
<tr><td>11</td><td>Multi-scattering with fixed model (Tropospheric, 90% humidity)</td></tr>
<tr><td>12</td><td>Multi-scattering with fixed model (Tropospheric, 99% humidity)</td></tr>
<tr><td>0</td><td>Single-scattering white aerosols</td></tr>
<tr><td>-1</td><td>Multi-scattering with 765/865 model selection</td></tr>
<tr><td>-2</td><td>Multi-scattering with 670/865 model selection (default for MOS)</td></tr>
<tr><td>-3</td><td>Multi-scattering with 765/865 model selection and NIR correction for non-zero nLw</td></tr>
</table>

	<table><tr><td>-4</td><td>Multi-scattering with 670/865 model selection and NIR correction for non-zero nLw</td></tr><tr><td>101</td><td>Multi-scattering with fixed model pair (requires * aermodmin, aermodmax, aermodrat specification)</td></tr><tr><td>102</td><td>Multi-scattering with fixed aerosol optical thickness (requires taua specification)</td></tr></table> ***aermodmin**=lower-bounding model to use for fixed model pair aerosol option (default: -1) ***aermodmax**=upper-bounding model to use for fixed model pair aerosol option (default: -1) ***aermodrat**=ratio to use for fixed model pair aerosol option (default: 0.0) ***taua**=user-fixed aerosol optical thicknesses at each band (default='[0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0]')
aer_iter_max	maximum number of iterations for NIR water-leaving radiance estimation. (default: 10)
albedo	Cloud threshold for band 8 surface reflectance setting the l2_flags bit #10. (Default=0.027).
glint_thresh	Sun glint threshold (fraction of F0 (865)) used in calculations for setting the l2_flags bit #4. (McClain et al., 1995). (Default=0.005)
absaer	Absorbing aerosol threshold on aerosol index. Set to -1 to avoid the computation entirely. (Default = 0.5)
sunzen	Solar zenith angle threshold (degrees) used for setting the l2_flags bit #13. (McClain et al., 1995). (Default=75.0)
satzen	Spacecraft zenith angle threshold (degrees) for setting the l2_flags bit #6. (McClain et al., 1995). (Default=60.0).
epsmin	Minimum epsilon value used for setting the l2_flags bit #23. (Default=0.85)
epsmax	Maximum epsilon value used for setting the l2_flags bit #23. (Default=1.35)
tauamax	Maximum 865 aerosol optical depth used for setting the l2_flags bit #14. (Default=0.3)
nlwmin	Minimum nlw(555) used for setting the l2_flags bit #15. (Default=0.15).
hipol	threshold on degree-of-polarization to set HIPOL flag (default=0.2)
wsmax	Windspeed limit on white-cap correction. (Default=8.0 m/s).

sl_frac	Lt 865 threshold for stray-light correction. (SeaWiFs only.) (Default= 0.25)
sl_pixl	Number of LAC pixels over which stray-light correction is applied. 0 = no correction, -1 = program defaults (4 for GAC, 3 for LAC)
rhoamin	Minimum NIR aerosol reflectance at which aerosol model selection will be attempted. (Default=0.0001)
windspeed	Wind speed ancillary override value. If greater than -999, the scalar values will be used to replace the interpolated ancillary inputs for every pixel in the scene. (Default = -1000). (m/s)
windangle	Wind direction ancillary override value. If greater than -999, the scalar values will be used to replace the interpolated ancillary inputs for every pixel in the scene. (Default = -1000). (deg, N=0 E=90)
pressure	Surface pressure ancillary override value. If greater than -999, the scalar values will be used to replace the interpolated ancillary inputs for every pixel in the scene. (Default = -1000). (mb)
ozone	Ozone concentration ancillary override value. If greater than -999, the scalar values will be used to replace the interpolated ancillary inputs for every pixel in the scene. (Default = -1000). (cm)
relhumid	Relative humidity ancillary override value. If greater than -999, the scalar values will be used to replace the interpolated ancillary inputs for every pixel in the scene. (Default = -1000). (%)
watervapor	Water vapor concentration ancillary override value. If greater than -999, the scalar values will be used to replace the interpolated ancillary inputs for every pixel in the scene. (Default = -1000). (g/cm^2)

Masking keywords:

maskland	Mask out all land pixels: 0=off, 1=on. (Default=1).
maskbath	Mask out shallow water: 0=off , 1=on. (Default=0).
maskcloud	Mask out pixels for which cloud albedo is above user defined threshold: 0=off,1=on. (Default=1).
maskglint	Mask out pixels with sun glint: 0=off, 1=on. (Default=0).
masksunzen	Mask out pixels with large solar zenith angle: 0=off, 1=on. (Default=0).
masksatzen	Mask out pixels with large sensor zenith angle: 0=off, 1=on. (Default=0).
maskhilt	Mask out pixels where total radiance greater than knee value: 0=off, 1=on. (Default=1).
maskstlight	Mask out pixels with stray light: 0=off, 1=on. (Default=1).
sl_frac	SeaWiFS only, straylight fractional threshold pn Ltpical (default=0.25
sl_pixl	SeaWiFS only, number of LAC pixels for straylight flagging (default=4 for GAC, default=3 for LAC)

L2GEN Output Product List

Ocean Color Products:

PRODUCT NAME	DESCRIPTION	UNITS
Lw_*nnn*	Water-leaving radiance	mw/cm^2/um/sr
nLw_*nnn*	Normalized water-leaving radiance	mw/cm^2/um/sr
Rrs_*nnn*	Remote sensing reflectance	
Kd_nnn_lee	Spectral Diffuse Attenuation Coefficient (Kd) algorithm	
chlor_a	Chlorophyll-a concentration, sensor default algorithm	mg/m^3
chl_oc2	Chlorophyll-a concentration, OC2 algorithm	mg/m^3
chl_oc3	Chlorophyll-a concentration, OC3 algorithm	mg/m^3
chl_oc4	Chlorophyll-a concentration, OC4 algorithm	mg/m^3
chl_octsc	Chlorophyll-a concentration, OCTS-C algorithm	mg/m^3
chl_ndpi	Chlorophyll-a concentration, Normalized Difference Pigment Index algorithm	mg/m^3
chl_carder	Chlorophyll-a concentration, Carder bio-optical model	mg/m^3
chl_clark	Chlorophyll-a concentration, Clark algorithm	mg/m^3
chl_gsm01	Chlorophyll-a concentration, Garver-Siegel-Maritorena-2001 bio-optical model	mg/m^3
poc_clark	Particular Organic Carbon (D.Clark)	mg/m^3
tsm_clark	Total suspended matter (D.Clark)	
a_nnn_gsm01	Garver-Siegel-Maritorena-2001 total absorption at sensor wavelength nnn	
bb_nnn_gsm01	Garver-Siegel-Maritorena-2001 total backscatter at sensor wavelength nnn	
bbp_nnn_gsm01	Garver-Siegel-Maritorena-2001 particulate backscatter at sensor wavelength nnn	
aph_nnn_gsm01	Garver-Siegel-Maritorena-2001 absorption due to phytoplankton at sensor wavelength nnn	
adg_nnn_gsm01	Garver-Siegel-Maritorena-2001 absorption due to gelbstof and detrital material at sensor wavelength nnn	
a_nnn_qaa	QAA (Quasi-Analytical Algorithm) model (Z.P.Lee) total absorption at sensor wavelength nnn	
bb_nnn_qaa	QAA (Quasi-Analytical Algorithm) model (Z.P.Lee) total backscatter at sensor wavelength nnn	
bbp_nnn_qaa	QAA (Quasi-Analytical Algorithm) model (Z.P.Lee) particulate backscatter at sensor wavelength nnn	

aph_nnn_qaa	QAA (Quasi-Analytical Algorithm) model (Z.P.Lee) absorption due to phytoplankton at sensor wavelength nnn	
adg_nnn_qaa	QAA (Quasi-Analytical Algorithm) model (Z.P.Lee) absorption due to gelbstof and detrital material at sensor wavelength nnn	
a_nnn_carder	Carder total absorption at sensor wavelength nnn	
bb_nnn_carder	Carder total backscatter at sensor wavelength nnn	
bbp_nnn_carder	Carder particulate backscatter at sensor wavelength nnn	
aph_nnn_carder	Carder absorption due to phytoplankton at sensor wavelength nnn	
adg_nnn_carder	Carder absorption due to gelbstof and detrital material at sensor wavelength nnn	
flags_carder	Carder model flags	
calcite	Calcite concentration (merged 2-band & 3-band of Gordon and Balch)	moles/m^3
calcite_2b	Calcite concentration, 2-band algorithm (Gordon and Balch)	moles/m^3
calcite_3b	Calcite concentration, 3-band algorithm (Gordon and Balch)	moles/m^3
flh	Fluorescence line height	
cfe	Chlorophyll fluorescence efficiency	
par	Photosynthetically active radiation	E/m^2/day
ipar	Instantaneous photosynthetically available radiation	
arp	Instantaneous absorbed radiation by phytoplankton	
l2_flags	Level 2 processing flags	

Ocean Temperature Products:

PRODUCT NAME	DESCRIPTION	MSL12 VERSION ADDED:	UNITS
sst	Sea Surface Temperature using 11-12um Channels		degC
sst4	Sea Surface Temperature using 4um Channels		degC
qual_sst	Quality Levels for sst		
qual_sst4	Quality Levels for sst4		
bias_sst	Bias error for sst		degC
bias_sst4	Bias error for sst4		degC
stdv_sst	Standard deviation error for sst		degC

stdv_sst4	Standard deviation error for sst4		degC
BT_11	Brightness Temperature at 11 um		degrees C
BT_12	Brightness Temperature at 12 um		degrees C
BT_39	Brightness Temperature at 3.9 um		degrees C
BT_40	Brightness Temperature at 4.0 um		degrees C

Atmospheric Correction and Other Intermediate Products:

PRODUCT NAME	DESCRIPTION	UNITS
Es_*nnn*	Extraterrestrial solar irradiance	mw/cm^2/um
t_sol_*nnn*	diffuse transmittance, Sun to ground	
t_sen_*nnn*	diffuse transmittance, ground to sensor	
t_oz_sol_nnn	Ozone transmittance, sun to ground	
t_oz_sen_nnn	Ozone transmittance, ground to sensor	
t_o2_*nnn*	Total oxygen transmittance	
glint_coeff	Glint radiance normalized by solar irradiance (ocean only)	
aerindex	Aerosol index (for identification of absorbing aerosols) (ocean only)	
cloud_albedo	Reflectance used for cloud/ice thresholding (historical name)	
aer_model	aerosol model #	
aer_model_min	Minimum bounding aerosol model # (ocean only)	
aer_model_max	Maximum bounding aerosol model # (ocean only)	
aer_model_ratio	Model mixing ratio (ocean only)	
aer_num_iter	Number of aerosol iterations, NIR correction (ocean only)	
epsilon	Retrieved epsilon used for model selection at 765 and 865 nm (used for calibration - float format - ocean only)	
eps_78	Retrieved epsilon used for model selection at 765 and 865 nm (Alternate name for epsilon) (scaled to byte)	
angstrom_*nnn*	Aerosol angstrom coefficient	
taua_*nnn*	Aerosol optical depth	
Lr_*nnn*	Rayleigh radiance	mw/cm^2/um/sr
La_*nnn*	Aerosol radiance (ocean only)	mw/cm^2/um/sr
TLg_*nnn*	Top-of-atmosphere(TOA) glint radiance (ocean only)	mw/cm^2/um/sr

tLf_*nnn*	Foam (white-cap) radiance (ocean only)	mw/cm^2/um/sr
brdf_*nnn*	Bi-directional reflectance correction factor (Morel, et al.) (ocean only)	
fsol	Solar distance correction factor per scan	

Input Ancillary Products:

PRODUCT NAME	DESCRIPTION	UNITS
ozone	Ozone concentration (from input ancillary data)	
windspeed	Magnitude of wind (m/s)	
windangle	Wind direction (deg) N=0, E=90	
zwind	Zonal wind speed (m/s)	
mwind	Meridional wind speed (m/s)	
water_vapor	Precipitable water concentration	g/cm^2
pressure	Barometric Pressure	mb
humidity	Relative Humidity	%
sstref	Sea Surface Temperature (interpolated from climatology to pixel location)	deg C

Geometry:

PRODUCT NAME	DESCRIPTION	UNITS
solz	Solar zenith angle	deg
sola	Solar azimuth angle	deg
senz	Sensor zenith angle	deg
sena	Sensor azimuth angle	deg
height	Terrain height	m